Carbon will travel in the system from plant to person to incinerator and back to the plant without ever becoming a stored waste.

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## Development of the Vapor Phase Catalytic Ammonia Removal Process

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The Vapor Phase Catalytic Ammonia Removal (VPCAR) system technology represents the next generation in spaceflight water recovery systems. Water is the single largest resupply requirement associated with human space flight, accounting for 87% by mass of an astronaut's daily metabolic requirement. The VPCAR system achieves a mass metric almost an order of magnitude better than the current state-of-the-art water processors. (Mass metric is a technique used to compare candidate technologies by reducing all performance parameters into a single equivalent launch mass metric.) Incorporating the VPCAR technology into human space flight missions could potentially save hundreds of millions of dollars in resupply costs, depending on the specific mission scenario. As a result, a human-rated version of the VPCAR technology has been authorized for development.

The human-rated system is being developed under contract to Water Reuse Technology (NAS2-00089). This is an external contract for the development and testing of the next generation VPCAR technology. We are currently about 1/2 way through a two-year contracted development program. This activity is funded through Advanced Life Support program funds and a NASA peer reviewed NRA (00-HEDS-01).

**Process Description.** The VPCAR process is a two-step distillation-based water processor. The current configuration of the technology is shown in Figure 1. A process flow diagram is

*Fig. 1. Vapor Phase Catalytic Ammonia Removal (VPCAR) water recycling system.*

provided in Figure 2. The VPCAR process is characterized by the use of a wiped-film rotating-disk vacuum evaporator to volatilize water, small molecular weight organics, and ammonia. This vapor stream is then oxidized in a vapor phase catalytic reactor to destroy any contaminants. The VPCAR process uses two catalytic beds to oxidize contaminants and decompose any nitrous oxide ($N_2O$) produced in the first bed. The first catalytic bed oxidizes organics to carbon dioxide and water, and ammonia to $N_2O$ and water. This oxidation reactor contains 1% platinum on alumina pellets and operates at about 523 K. The second catalytic bed reduces the $N_2O$ to nitrogen and oxygen. This reduction catalyst contains 0.5% ruthenium on alumina pellets and operates at about 723 K. The reactor and distillation functions occur in a single modular process step. The process achieves between 97-98% water recovery and has no scheduled maintenance or resupply requirements for a minimum of three years.

The VPCAR activity is significant in that it represents the development of the next generation of life support water recovery technology. Ames Research Center's involvement has spanned from the first principle definition to the model development, bench-scale and lab-scale prototype development, and most recently, contract management of the development of a human-rated version of the technology for evaluation for spaceflight application.

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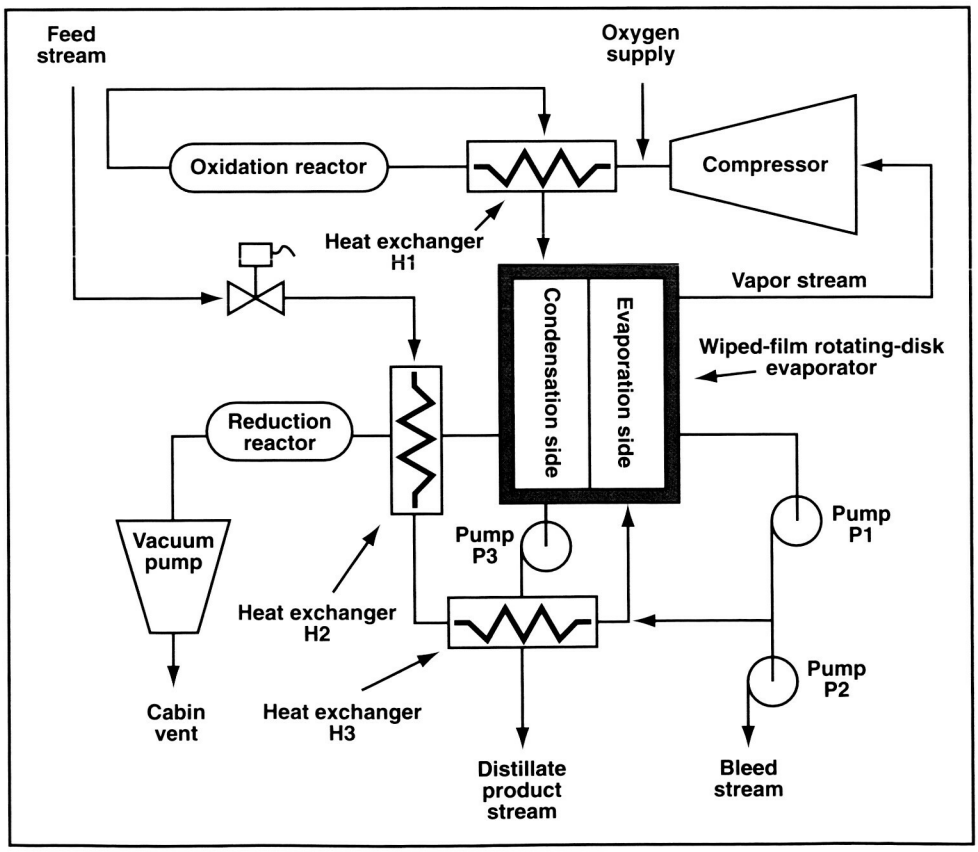


*Fig. 2. VPCAR Flow Diagram.*